NEW SPECIES OF STELLICOLA (COPEPODA, CYCLOPOIDA) ASSOCIATED WITH STARFISHES IN MADAGASCAR, WITH A REDESCRIPTION OF S. CAERULEUS (STEBBING, I900)

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Pp. 199-225; 17 Plates

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY) ZOOLOGY

Vol. is No. 5
LONDON: 1967

THE BULLETIN OF THE BRITISH MUSEUM (NATURAL HISTORY), instituted in 1949, is issued in five series corresponding to the Departments of the Museum, and an Historical series.

Parts will appear at irregular intervals as they become ready. Volumes will contain about three or four hundred pages, and will not necessarily be completed within one calendar year.

In I965 a separate supplementary series of longer papers was instituted, numbered serially for each Department.

This paper is Vol. I5, No. 5 of the Zoological series. The abbreviated titles of periodicals cited follow those of the World List of Scientific Periodicals.

World List abbreviation: Bull. Br. Mus. nat. Hist. (Zool.).

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# NEW SPECIES OF STELLICOLA (COPEPODA, CYCLOPOIDA) ASSOCIATED WITH STARFISHES IN MADAGASCAR, WITH A REDESCRIPTION OF S. CAERULEUS (STEBBING, 1900) 

By ARTHUR G. HUMES \& JU-SHEY HO

## INTRODUCTION

Two species of the lichomolgid genus Stellicola (a genus usually living in association with asteroid echinoderms) are known from starfishes in the region of Nosy Bé, in northwestern Madagascar. S. oveastriphilus Kossmann, r877, occurs commonly on Protoreaster lincki (Blainville), Culcita schmideliana (Retzius), Pentaceraster mammillatus (Audouin), and Poraster superbus (Möbius) (Humes \& Cressey, 1961), and more rarely on Choriaster granulatus (Lütken) (Humes \& Ho, in press). A second species of Stellicola, whose description by Humes and Ho is in press, also occurs on Choriaster granulatus. Five new species from the region of Nosy Bé are now to be added, bringing the total number of species in that area to seven.

The field work was done by the first author, in 1960 while a member of an expedition sent to Madagascar by the Academy of Natural Sciences of Philadelphia, and in 1963-64 while participating in the U.S. Program in Biology of the International Indian Ocean Expedition.

The study of the material has been aided by a grant (GB-I809) from the National Science Foundation of the U.S.

We wish to thank Dr. H. Barraclough Fell and Mr. James F. Clark of the Museum of Comparative Zoology, Harvard University, for the identifications of the starfishes collected in 1963-64 (with the exception of the Retaster cribrosus from Ankify which was determined by Dr. G. Cherbonnier of the Muséum National d'Histoire Naturelle in Paris) and Dr. Elisabeth Deichmann, also of the Museum of Comparative Zoology, for determining the starfishes collected in 1960 . It is a pleasure also to acknowledge the assistance given to the field work by the staff at the Centre d'Océanographie et des Pêches et Nosy Bé during the eighteen months while the first author was resident there.

We are also indebted to Dr. J. P. Harding of the British Museum (Natural History) for information on the whereabouts of Thompson and A. Scott's Ceylonese copepods and to Miss Patricia D. Lofthouse of the same museum for arranging the loan of syntypes of $S$. caeruleus with permission to dissect a male and a female.

The material covered in this paper comprises :

> Stellicola kossmanni, new species
> Stellicola affinis, new species
> Stellicola longiseta, new species
> Stellicola femineus, new species
> Stellicola pollex, new species
> Stellicola oreastriphilus Kossmann, redescription in part
> Stellicola caeruleus (Stebbing), redescription of syntypes

## STELLICOLA Kossmann, I877

## Stellicola kossmanni n. sp.

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\text { Pl. I, figs. I-6; Pl. 2, figs. } 7-15 \text {; Pl. 3, figs. I6-2I; Pl. 4, figs. 22-24. }
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Type material. $4 \%$ and I4 $\begin{gathered}\text { trom washings of } 83 \text { starfishes, Protoreaster }\end{gathered}$ lincki (Blainville), in a depth of 0.5 m . at Pte. Antsamantsara, west of Madirokely, Nosy Bé, Madagascar. Collected 7th July, I963. Holotype female, allotype, and I3 paratypes ( 2 ㅇ, II of) deposited in the British Mus. (Nat. Hist.) Reg. No. I966.I2.7.I-3; the remaining 3 paratypes (dissected) in the collection of A. G. Humes.

Other specimens (all from Protoreaster lincki in 0.5 m .). 6 ㅇ, $6 \sigma_{0}^{\lambda}$ from 7 hosts, Pte. Mahatsinjo, Nosy Bé, 4th July, I963 ; I P, 6 ô from 60 hosts at Pte. Lokobe, Nosy Bé, IIth July, 1963.

Female. Body (Pl. I, fig. I) with moderately broadened prosome. Length (not including setae on caudal rami) $I .0 \mathrm{~mm}$. ( $0.95-\mathrm{I} .03 \mathrm{~mm}$.) and greatest width 0.46 mm . ( $0.44-0.47 \mathrm{~mm}$.), based on 10 specimens (holotype, 3 paratypes, and 6 specimens from Pte. Mahatsinjo, 4 th July, I963). Ratio of length to width of prosome I•45: I. Segment of leg I separated dorsally and laterally from head by a furrow. Epimeral areas of segments of legs $I-4$ rounded ; lateral margins of segments of legs $I-3$ with membrane (Pl. I, fig. 2).

Segment of leg 5 (Pl. I, fig. 3) $83 \mu$ long and $105 \mu$ in greatest width ; fifth legs borne slightly dorsally. Between this segment and genital segment a short intersegmental sclerite ventrally. Genital segment longer than wide, I46 $\mu$ in length, I27 $\mu$ in width in its anterior three-fourths where its lateral margins are somewhat irregular, and $85 \mu$ in width in its constricted posterior fourth. Areas of attachment of egg sacs situated dorsolaterally just in front of posteriormost fourth ; each area (Pl. I, fig. 4) with 2 long setae (outer $82 \mu$ long and bearing minute unilateral spinules, inner $36 \mu$ and feathered) and between them a small spinous process $6 \mu$ long. Posterior margin of segment with a membrane having a ragged edge simulating small spinules especially laterally. Three postgenital segments, first $44 \times 75 \mu$ with a similar posterior membrane, second $18 \times 68 \mu$, and third $28 \times 65 \mu$.

Caudal ramus (Pl. I, fig. 5), inserted ventrally on anal segment, quadrate, $31 \times 29 \mu$. Long naked setule ( $34 \mu$ ) midway on outer margin. Pedicellate dorsal seta $65 \mu$ and haired. Outer lateral seta $\operatorname{Iog} \mu$ and naked, inserted close to outermost terminal seta ( $556 \mu$, with a few spinules on each side in its proximal third). Innermost terminal seta $216 \mu$ and naked. Two long terminal setae, inserted between dorsal (smooth) and ventral (with a row of prominent setules) flaps, $429 \mu$ (outer) and $600 \mu$ (inner) and both with lateral spinules; " pegged " region of these two setae finely punctate. A small hair on ventral surface of ramus.

Dorsal surface of prosome with scattered hairs (sensilla). Dorsal surface of urosome with hairs as shown in Pl. I, fig. 3 ; ventral surface less ornamented with hairs. Ratio of length of prosome to that of urosome $I \cdot 87: I$.

Egg sac (Pl. r, fig. I) elongated, $520 \times 275 \mu$, extending far beyond caudal rami, and containing many eggs about $50 \mu$ in diameter.

Rostral area (Pl. I, fig. 6) rounded, not strongly sclerotized.
First antenna (Pl. 2, fig. 7) 7-segmented, lengths of segments (measured along their posterior non-setiferous margins) being 39 ( $50 \mu$ along anterior margin), 74, $3 \mathrm{I}, 4 \mathrm{I}, 34, \mathrm{I} 8$, and $\mathrm{I} 6 \mu$ respectively. Formula for armature: 4 , $13(5+2+6)$, $6,3,4+\mathrm{I}$ aesthete, $2+\mathrm{I}$ aesthete, and $7+\mathrm{I}$ aesthete. All setae naked except I on second segment and 4 on last 3 segments which are delicately haired. Terminal seta on segment 7 very long $(260 \mu)$, equal to length of entire first antenna. Aesthete on segment 7 arising from common base with adjacent long naked seta. Ventral surface of segment 3 with sclerotization suggesting an intercalary segment.

Second antenna (Pl. 2, fig. 8) relatively slender and 3-segmented, third segment showing a partial division on anterior surface but entire posteriorly. First segment with a smooth seta, second with a haired seta, and third with 3 haired setae near the incomplete division and terminally with 6 elements : a stout claw $42 \mu$ along its axis, 4 long naked setae, and a short blunt naked seta. Anterior surface of second antenna pilose, with 4 slender setules subterminally on last segment. Long setae annulated.

Labrum (Pl. 2, fig. 9) with its two posteroventral lobes somewhat angular and unornamented.

Mandible (Pl. 2, fig. 10) with an outer row of slender spinules and an inner row of rather stout blunt teeth preceded proximally by a prominent dentiform process ; both rows diminishing to minute spinules along the slender terminal lash. Paragnath a small lobe hidden under lobe of labrum in ventral view. First maxilla (Pl. 2, fig. II) an elongated lobe with 3 naked setae and I stout spiniform element strongly spinose on its posterolateral surface. Second maxilla (Pl. 2, fig. I2) 2-segmented ; first segment unarmed, its proximal ventral margin projecting strongly; second segment with 2 postero-inner elements (a slender seta with short lateral spinules and a spine with rows of spinules) and terminating in a spiniform process bearing rows of teeth as in the figure (proximal tooth larger than others, producing a bifurcated appearance). Maxilliped (Pl. 2, fig. 13) 3-segmented ; first segment unarmed, second with 2 setae and anterior surficial spinules, and third with 2 setae ( I with lateral spinules, other naked) and terminating in a spiniform process bearing lateral spinules.

Area between maxillipeds and first pair of legs (Pl. 2, fig. I4) not protuberant, with a distinct sclerotized line between bases of maxillipeds.

Rami of legs I-4 (Pl. 2, fig. I5, Pl. 3, figs. I6, I7, and I8) 3-segmented, except endopod of leg 4 which is weakly 2 -segmented. Spine and setal formula as follows (Roman numerals indicating spines, Arabic numerals setae) :

| $\mathrm{P}_{1}$ | protopod | $\mathrm{O}-\mathrm{I} ;$ | $\mathrm{I}-\mathrm{O}$ | exp | $\mathrm{I}-\mathrm{O} ;$ | $\mathrm{I}-\mathrm{I} ;$ | $\mathrm{III}, \mathrm{I}, 4$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
|  |  |  |  | end | $\mathrm{O}-\mathrm{I} ;$ | $\mathrm{O}-\mathrm{I} ;$ | $\mathrm{I}, 5$ |
| $\mathrm{P}_{2}$ | protopod | $\mathrm{O}-\mathrm{I} ;$ | $\mathrm{I}-\mathrm{O}$ | exp | $\mathrm{I}-\mathrm{O} ;$ | $\mathrm{I}-\mathrm{I} ;$ | $\mathrm{III}, \mathrm{I}, 5$ |
|  |  |  |  | end | $\mathrm{O}-\mathrm{I} ;$ | $\mathrm{O}-2 ;$ | $\mathrm{I}, \mathrm{II}, 3$ |
| $\mathrm{P}_{3}$ | protopod | $\mathrm{O}-\mathrm{I} ;$ | $\mathrm{I}-\mathrm{O}$ | exp | $\mathrm{I}-\mathrm{O} ;$ | $\mathrm{I}-\mathrm{I} ;$ | $\mathrm{III}, \mathrm{I}, 5$ |
|  |  |  |  | end | $\mathrm{O}-\mathrm{I} ;$ | $\mathrm{O}-2 ;$ | $\mathrm{I}, \mathrm{II}, 2$ |
| $\mathrm{P}_{4}$ | protopod | $\mathrm{O}-\mathrm{I} ;$ | $\mathrm{I}-\mathrm{O}$ | exp | $\mathrm{I}-\mathrm{O} ;$ | $\mathrm{I}-\mathrm{I} ;$ | $\mathrm{II}, \mathrm{I}, 5$ |
|  |  |  |  | end | $\mathrm{O}-\mathrm{I} ;$ | $\mathrm{II}, \mathrm{I}$ |  |

Inner seta on coxa feathered in legs I-3 but naked ( $42 \mu$ long) in leg 4. Hairs on inner margin of basis in legs I-3 absent in leg 4. Expansion of basis over anterior surface of first segment of exopod rather acute. Between 2 terminal spines on last segment of endopod of leg 2 a bifurcated spinous process. On second segment of exopod of leg 4 relatively short inner seta lying (in alcoholized specimens) nearly parallel to ramus and having short lateral spinules instead of the usual long hairs. Endopod of leg 4 two-segmented, with a line of separation visible on both anterior and posterior surfaces, but with the lateral sclerotization continuous between the two segments. First segment $26 \times 24 \mu$ (greatest dimensions) with inner distal seta $84 \mu$ long, spiniform, with short lateral spinules. Second segment $46 \times 2$ I $\mu$ (greatest dimensions), the feathered inner seta $67 \mu$, the 2 terminal spines $105 \mu$ (inner) and $58 \mu$ (outer) both with delicately serrate lamellae; a row of minute spinules anteriorly across end of segment near insertions of 2 spines, and a row of hairs on proximal half of outer margin of segment.

Leg 5 (Pl. 3, fig. 19) with free segment elongated, $32 \times 14 \mu$. Two very unequal terminal setae, outer $102 \mu$ long, with minute lateral spinules, inner $55 \mu$, with delicately serrate lamellae. Seta on body near insertion of free segment $40 \mu$ and feathered.

Leg 6 probably represented by the 2 setae on area of attachment of egg sac (see Pl. I, figs. 3 and 4).

Colour in life in transmitted light faintly reddish, eye red, intestine dark brown, ovary reddish brown.

Male. Body form (Pl. 3, fig. 20) resembling that of female, though prosome somewhat narrower. Length (excluding setae on caudal rami) 0.7 I mm . ( $0.69-0.74$ mm .) and greatest width 0.27 mm . ( $0.26-0.28 \mathrm{~mm}$.), based on Io specimens. Ratio of length to width of prosome $\mathrm{r} \cdot 72: \mathrm{I}$.

Segment of leg 5 (Pl. 3, fig. 21) $33 \times 70 \mu$. Ventral intersegmental sclerite absent. Genital segment about as long as wide, $99 \times 94 \mu$, with slightly rounded lateral margins in dorsal view. Four postgenital segments $42 \times 66,34 \times 58$, II $\times 50$, and $2 \mathrm{I} \times 52 \mu$ from anterior to posterior.

Caudal ramus like that of female but smaller, $23 \times 23 \mu$.
Surfaces of prosome and urosome, as in female, ornamented with hairs. Ratio of length of prosome to that of urosome $1 \cdot 85:$.

Rostral area, first antenna, second antenna, labrum, mandible, paragnath, first maxilla, and second maxilla like those of female. Maxilliped (Pl. 4, fig. 22) slender and 4 -segmented. First segment unarmed, second with 2 naked setae and 2 rows of spinules, and third small and unarmed. Proximal part of terminal claw probably representing fourth segment. Claw ror $\mu$ in length (measured along its axis), recurved, showing a slight evidence of division about midway and having a fringe of delicate hyaline spinules along its concave edge; bearing 2 setae proximally, one small naked and hyaline $12 \mu$ long, other long ( $50 \mu$ ) with a few distal spinules.

Area between maxillipeds and first pair of legs like that in female.
Legs I-4 resembling those of female, with same spine and setal formula. Endopod of leg 4 with 2 terminal spines differing in their proportional lengths. Measurements
for this ramus: first segment $19 \times 18 \mu$ with seta $66 \mu$, second segment $33 \times 17 \mu$ with seta $45 \mu$ and 2 terminal spines $80 \mu$ and $47 \mu$ (ratio of these 2 spines $I \cdot 7: I$, instead of $I \cdot 8$ : I in female).

Leg 5 resembling that of female, with free segment $2 I \times 8 \mu$ and 2 terminal elements $70 \mu$ and $34 \mu$ respectively.

Leg 6 (Pl. 4, fig. 23) consisting of posterolateral flap on ventral surface of genital segment and bearing a minute spiniform process and 2 unequal setae, one naked $(69 \mu)$, other feathered $(33 \mu)$. In view of entire urosome these setae conspicuous (see Pl. 3, fig. 2I).

Spermatophore (Pl. 4, fig. 24), inside body of male, elongated, $86 \times 3$ I $\mu$ without neck.

Colour in life in transmitted light resembling that of female.
(This species is named for Dr. Robby Kossmann, who originally described the genus Stellicola).

Comparison with related species. There are at present fifteen species known with some certainty to belong to the genus Stellicola (I4 with published descriptions and I whose description by Humes and Ho is in press). Stock (r957) included S. thorelli Kossmann, 1877, S. pleurobranchi Kossmann, 1877, S. oreastriphilus Kossmann, 1877, S. caeruleus (Stebbing, Igoo), S. curticaudatus (Thompson \& A. Scott, I903), S. gracilis (Thompson \& A. Scott, Igo3), S. lankensis (Thompson \& A. Scott, I903), and S. asterinae (Bocquet, I952), a species later synonymized with S. clausi (Rosoll, 1889) by Bocquet and Stock (r962). The four West African species (S. frequens, S. astropectinis, S. luidiae, and S. lautus) originally described by Humes \& Cressey (I958) in the genus Lichomolgus also belong to Stellicola, as pointed out by Bocquet and Stock (1962). In Stellicola there should also be included S. holothuriae (Ummerkutty, I96I) and probably S. longicaudatus (Thompson \& A. Scott, 1903).
S. kossmanni may be separated from these fifteen species as follows: in gracilis, lankensis, and the new species of Humes \& Ho (in press) there are two postgenital segments in the female and three in the male; in frequens, astropectinis, luidiae, and lautus there are three claws on the second antenna; in clausi there are two claws on the second antenna; and in oreastriphilus, holothuriae, thorelli, pleurobranchi, curticaudatus, longicaudatus, and caeruleus, although the second antenna has only a single claw, the length ratio of prosome to urosome in the female (ranging from $2 \cdot 3-3 \cdot 3:$ I) is distinctly more than 2 : I.
S. kossmanni shows several features which may be used as identifying characters : the very long terminal seta on the first antenna (as long as the antenna itself), the four slender subterminal setules on the second antenna (these in addition to the six terminal elements), the strongly spinose element on the first maxilla, and in leg 4 the detailed ornamentation of the four elements on the endopod and the nature of the inner seta on the second segment of the exopod.

## Stellicola affinis n. sp.

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\text { Pl. 4, figs. 25-3I; Pl. 5, figs. } 32-4 \text { I; Pl. 6, figs, } 42-48 .
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Type material. 84 ㅇ and 26 ô washed from 2 starfishes, Maculaster maculata maculata (Müller \& Troschel), exposed on sand bar at low tide on the eastern side of Ankify, on the mainland of Madagascar, opposite Nosy Komba, and about 15 kilometers south of Nosy Bé. Collected 8th August, I964. Holotype female, allotype, and 5I paratypes ( 40 \& , II ${ }^{\top}$ ) deposited in the British Mus. (Nat. Hist.) Reg. No. Ig66.12.7.4-6; 27 paratypes ( 20 ㅇ, 7 万 ) in the United States National Museum, Washington; and the remaining paratypes in the collection of A. G. Humes.

Other specimens (all in the vicinity of Nosy Bé). From Maculaster maculata maculata: I6 ㅇ, 8 of from I host, exposed on sand bar at Ankify (the type locality), 9th September, 1964. From Maculaster savignyi (Audouin): 38 9,6 from 9 hosts, exposed on sand bar at Ankify, 8th August, I964; 60 ㅇ, 27 ot from I host, in 2 m ., eastern shore of Ambariobe, a small island between Nosy Komba and Nosy Bé, 4th October, I964; I2 9,3 đ̂ from I host, on sand exposed at low tide, Ambariobe, 2Ist July, 1963. From Retaster cribrosus von Martens : II ㅇ, 5 đ from I host, exposed on sand bar, Ankify, 2nd November, 1963. From Luidia maculata Müller \& Troschel : $35^{\text {아, }} 16$ ô from 2 hosts, dredged in 17 m ., $13^{\circ} \mathrm{I} 6^{\prime} \mathrm{S}, 48^{\circ} 3 \mathrm{I}^{\prime} 30^{\prime \prime} \mathrm{E}$, northeast of Nosy Faly, I4th September, 1960.

Female. Body (Pl. 4, figs. 25 and 26) relatively slender. Length (not including setae on caudal rami) r.OI mm. ( $0.98-\mathrm{I} .04 \mathrm{~mm}$.) and greatest width 0.35 mm . $(0.32-0.37 \mathrm{~mm}$.$) , based on 10$ specimens. Ratio of length to width of prosome $\mathrm{x} \cdot 56$ : x. Epimeral areas of segment of leg 4 pointed.

Segment of leg 5 (Pl. 4, fig. 27) $6 \mathrm{I} \times 97 \mu$. Between this segment and genital segment a short intersegmental sclerite ventrally. Genital segment elongated, I56 $\mu$ in length, being somewhat wider in its anterior two-thirds ( $\operatorname{Iog} \mu$ ) than in its posterior third $(80 \mu)$. Areas of attachment of egg sacs located dorsolaterally on anterior part of middle third ; each area (Pl. 4, fig. 28) bearing 2 short naked setae (outer I3 $\mu$ long, inner I7 $\mu$ ), with a small spinous process about $5 \mu$ long between them. Two postgenital segments, first $56 \times 63 \mu$, second (anal) $43 \mu$ long and $72 \mu$ in greatest width (this segment deeply incised).

Caudal ramus (Pl. 4, fig. 29) divergent, inserted a little ventrally on anal segment, elongated and somewhat narrowed distally, in one female $106 \mu$ (greatest length) $\times$ I5 $\mu$ (width taken at level of outer seta) making a ratio of $7: I$, in another female Io8 $\times$ I7 $\mu$, ratio of $6 \cdot 3:$ I. Minute setule ( $4 \mu \mathrm{long}$ ) on outer proximal margin. Another small setule ( $8 \mu$ ) on outer margin just beyond midpoint of ramus (perhaps corresponding to long marginal setule in S. kossmanni). Pedicellate dorsal seta $25 \mu$. Outer lateral seta $74 \mu$, inserted near end of ramus. Innermost terminal seta I30 $\mu$, outermost terminal seta $88 \mu$, and 2 long median terminal setae, inserted between dorsal (smooth) and ventral (with a row of minute spinules) flaps, $242 \mu$ (outer) and $363 \mu$ (inner). All setae naked. Both outer and inner walls of ramus with an interruption in sclerotization as shown in figure. Two minute hairs on ventral surface of ramus.

Dorsal surface of prosome with scattered hairs. Dorsal surface of urosome with hairs as shown in Pl. 4, fig. 27 ; ventral surface much less ornamented with hairs. Ratio of length of prosome to that of urosome $\mathrm{I} \cdot 30$ : I.
Egg sac (Pl. 4, fig. 25) fairly elongated, $374 \times \mathrm{I} 43 \mu$, extending not quite to the ends of caudal rami, and containing a moderate number of eggs about $50 \mu$ in diameter.

Rostral area (Pl. 4, fig. 30) rounded.
First antenna (Pl. 4, fig. 3I) 7 -segmented, lengths of segments (measured along their posterior non-setiferous margins) being 30 ( $47 \mu$ along anterior margin), 67, 23, 25, 3I, 19, and $14 \mu$ respectively. Formula for armature as in S. kossmanni. Setae naked except for I on antepenultimate segment, I on penultimate segment, and 2 on last segment which are delicately haired. Long terminal seta $213 \mu$ in length, nearly as long as entire first antenna. Aesthete on last segment having a common base with adjacent seta. Sclerotization on ventral surface of segment 3 suggesting an intercalary segment.
Second antenna (Pl. 5, fig. 32) 3-segmented, with no evidence of division of third segment. Armature I; I; $3+5+\mathrm{I}$ claw, as in S. kossmanni, though relative lengths and fine ornamentation of setae different (compare Pl. 2, fig. 8 and Pl. 5, fig. 32). Claw 4I $\mu$ along its axis. Anterior surface of second antenna not pilose as in S. kossmanni ; posterior surface with very fine punctations.

Labrum (Pl. 5, fig. 33) with subtriangular unornamented lobes.
Mandible (Pl. 5, fig. 34) in general resembling that of S. kossmanni, but first element in inner row of teeth less prominent and terminal lash relatively shorter. Paragnath a small indistinct lobe medial to insertions of mandible and first maxilla (Pl. 5, fig. 38). Four elements on first maxilla (Pl. 5, fig. 35), including spine with lateral rows of spinules. Second maxilla (Pl. 5, fig. 36) 2 -segmented, with proximal ventral margin of unarmed first segment rather angularly produced ; second segment with long inner spine having serrated flanges (with serrations especially prominent along distal flange) and with terminal process bifurcated as shown in figure. Maxilliped (Pl. 5, fig. 37) 3-segmented, with armature resembling that of S. kossmanni; second segment lacking rows of small spinules seen in that species.

Area between maxillipeds and first pair of legs only slightly protuberant (Pl. 4, fig. 26) ; a sclerotized line connecting bases of maxillipeds (Pl. 5, fig. 38).
Rami of legs I-4 (Pl. 5, figs. 39, 40, 4r, and Pl. 6, fig. 42) with same segmentation and spine and setal formula as in S. kossmanni. Inner seta on coxa relatively long and feathered in legs $\mathrm{I}-3$ but short ( $\mathrm{I} 9 \mu$ ) and naked in leg 4. Hairs on inner margin of basis absent in leg 4 and apparently also in leg r. In legs I-3 expansion of basis over anterior surface of first segment of exopod with membranous tip ; this expansion absent in leg 4. Second segment of exopod of leg 4 with inner seta like that in S. kossmanni. Endopod of leg 4 two-segmented, with distinct articulation between these segments. First segment $3 I \times 25 \mu$ (greatest dimensions) with finely barbed inner seta $9 \mathrm{r} \mu$ long. Second segment $50 \times 24 \mu$ (greatest dimensions), the inner seta finely barbed and $48 \mu$, the 2 terminal spines $62 \mu$ (inner) and 5 I $\mu$ (outer), both with delicately serrate lamellae. Rows of long hairs along outer margins of both segments, with row on second segment interrupted. Row of minute spinules
on anterior surface across end of segment near insertions of 2 spines.
Leg 5 (Pl. 6, fig. 43) with elongated free segment, $28 \times 13 \mu$. Two unequal terminal setae, outer $6 \mathrm{I} \mu$ long with a few minute barbs distally, inner $39 \mu$ with outer serrated fringe. Seta on body near insertion of free segment $25 \mu$ long and delicately feathered.

Leg 6 probably represented by the 2 setae on area of attachment of egg sac (see Pl. 4, fig. 28).

Colour in life in transmitted light slightly opaque, ovary dark gray, eye dark blackish red, egg sacs dark gray.

Male. Body form (Pl. 6, fig. 44) resembling that of female but more slender. Length (without ramal setae) 0.78 mm . ( $0.75-0.82 \mathrm{~mm}$.) and greatest width 0.22 mm . $(0.2 \mathrm{I}-0.23 \mathrm{~mm}$.), based on 10 specimens. Ratio of length to width of prosome I• 84 : .

Segment of leg 5 (Pl. 6, fig. 45) $3 I \times 65 \mu$. Ventral intersegmental sclerite absent. Genital segment subquadrate, I33 $\times I I 7 \mu$, a little longer than wide, with lateral borders nearly parallel in dorsal view. Three postgenital segments $47 \times 59$, $43 \times 46$, and $26 \times 46 \mu$ from anterior to posterior.

Caudal ramus (see Pl. 6, fig. 45) resembling that of female, but proportionately more slender, $90 \times 12 \mu$, with ratio of $7 \cdot 5: \mathrm{I}$, and a little more narrowed in its distal half.

Surfaces of prosome and urosome, as in female, ornamented with hairs. Ratio of length of prosome to that of urosome $I \cdot I 6: I$.

Rostral area, first antenna, second antenna, labrum, mandible, paragnath, and first maxilla like those of female. Second maxilla also resembling that of female but proximal ventral margin of first segment less produced and more rounded. Maxilliped (Pl. 6, fig. 46) slender and 4-segmented. First segment unarmed. Second segment with 2 slender naked setae and 2 rows of spinules (r row short, consisting of only about 5 spinules.) Third segment short and unarmed. Proximal part of claw probably representing fourth segment. Slender gently recurved claw III $\mu$ along its axis, with evidence of division about midway and having a fringe of delicate hyaline spinules along its concave margin; bearing proximally 2 setae, one II $\mu$ and naked, other $29 \mu$ long with a few minute barbs near its tip.

Area between maxillipeds and first pair of legs like that in female.
Legs I-4 resembling those of female, with same spine and setal formula. Endopod of leg 4 much like that in female, with 4 elements from inner to outer $72,35,43$, and $34 \mu$ long.

Leg 5 (Pl. 6, fig. 47) with free segment $2 \mathrm{I} \times 8 \mu$, more slender than in female, and 2 terminal setae more unequal, $53 \mu$ and $22 \mu$ (ratio of $2 \cdot 4: \mathrm{I}$, instead of $\mathrm{I} \cdot 56: \mathrm{I}$ in female).

Leg 6 (Pl. 6, fig. 48) consisting of posterolateral flap on ventral surface of genital segment and bearing 2 slender naked setae 25 and $38 \mu$ long.

Spermatophores not observed.
Colour in life in transmitted light resembling that of female.
[The specific name affinis, Latin = adjoining or related, refers to the close similarity of this species with Stellicola gracilis (Thompson \& A. Scott) as discussed below].

Comparison with other species. At present there are three species known in the genus Stellicola which, like S. affinis, have two postgenital segments in the female and three in the male. These are S. gracilis (Thompson \& A. Scott, 1903), S. lankensis (Thompson \& A. Scott, I903), and the species whose description by Humes and Ho is in press. S. lankensis (of which only the female is known), from washings of dredged invertebrates in Ceylon, has a much shorter caudal ramus (proportions of about $2.37:$ I in T. \& S.'s pl. XV, fig. 25). The new species of Humes and Ho differs in having a quadrate caudal ramus, in its smaller size (female 0.79 mm ., male 0.64 mm .), and in many other features.
S. gracilis, from washings of dredged invertebrates in Ceylon, is known only from the original description and figures by Thompson \& A. Scott. The existence of type material (the "several males and females" of Thompson \& A. Scott) is extremely doubtful. The type specimens of S. gracilis were apparently deposited in the University of Liverpool, where Dr. W. A. Herdman, the author of the Report on Pearl Oyster Fisheries, was professor of natural history. An inquiry recently made by Dr. J. P. Harding of the British Museum to the Department of Oceanography of Liverpool University drew the reply that the Andrew Scott collection had been discarded. Our only available information on S. gracilis is, then, to be found in the brief original description.

When $S$. affinis is compared with $S$. gracilis certain similarities are obvious. The two species are of about the same length and have the same number of postgenital segments. In the female of both the anal segment is cleft deeply, the caudal rami are divergent, the genital segment has a similar shape, the second antenna appears to have the same general form, the base of the mandible is somewhat angular. and the first segment of the second maxilla seems to project. In the male of both the maxilliped is rather similar.

There exist, however, differences between the two species which in our opinion make it impossible to regard them as one and the same species. In the female of S. gracilis the proportions of the caudal ramus are about 4 : I (instead of $6 \cdot 3:$ I or $7:$ I as in $S$. affinis), the two inner setae on the endopod of leg 4 are distinctly feathered (while in S. affinis these setae have very minute barbs), and (based on measurements of T. \& S.'s pl. XV, fig. I) the ratio of the length of prosome to urosome is $I: I(I \cdot 30: I$ in S. affinis) and the ratio of length to width of the prosome is $I \cdot 75: I$ ( $\mathrm{I} \cdot 56$ : I in S. affinis). T. \& S.'s pl. XV, fig. 4, shows only three elements on the first maxilla, but a fourth minute seta may have escaped their notice. They describe the tip of the second maxilla as " triangular, sharp and wedge-shaped ", illustrated on pl. XV, fig. 5, but their description is wanting in detail.

We conclude that $S$. affinis, while related to $S$. gracilis, is a separate species.

## Stellicola longiseta n . sp.

Pl. 6, figs. 49-50; Pl. 7, figs. 5I-60; Pl. 8, figs. 6I-66.
Type material. 2 早 and 30 from washings of I starfish, Mithrodia clavigera (Lamarck), under dead coral (Acropora) in a depth of I m., Pte. Ambarionaomby, Nosy Komba, near Nosy Bé, Madagascar. Collected 3rd September, I963. Holo-
type female, allotype, and 2 paratypes (I $\mathcal{q}, ~ I ~ \delta)^{1}$ ) deposited in the British Mus. (Nat. Hist.) Reg. No. Ig66.I2.7.7-9; the remaining paratypic male (dissected) in the collection of A. G. Humes.

Other specimens (from Mithrodia clavigera in the same locality). 2 \& from I host in I m., r4th December, 1963.

Female. Body (Pl. 6, fig. 49) with prosome relatively thickened as in S. affinis, but broader than in that species. Length (excluding setae on caudal rami) I•I8 mm. ( $\mathrm{I} \cdot \mathrm{I} 4-\mathrm{I} .22 \mathrm{~mm}$.) and greatest width 0.60 mm . $(0.58-0.62 \mathrm{~mm}$.), based on 4 specimens (holotype, I paratype, and 2 specimens collected on I4th December, I963). Ratio of length to width of prosome $\mathrm{I} \cdot 36: \mathrm{I}$. Segment of leg I separated from head by a dorsal and lateral furrow. Epimeral areas of segment of leg 2 rather pointed posteriorly ; those of segments of legs $I, 3$, and 4 rounded.

Segment of leg 5 (Pl. 6, fig. 50) $88 \times 146 \mu$. Between this segment and genital segment a short intersegmental sclerite ventrally. Genital segment a little longer than wide, $\mathrm{I} 77 \mu$ in length, $\mathrm{I} 59 \mu$ in width in its anterior two-thirds, and II4 $\mu$ in width in its constricted posterior third, and showing a slight middorsal hump anteriorly. Areas of attachment of egg sacs situated dorsolaterally on anterior part of posterior third ; each area (Pl. 6, fig. 50) with 2 setae (outer $77 \mu$ long and naked, inner $23 \mu$ and feathered) and between them a small spinous process $6 \mu$ long. Posterior margin of genital segment with a membrane which simulates spinules laterally. Two postgenital segments $52 \times 95$ and $34 \times 88 \mu$ respectively.

Caudal ramus (Pl. 7, fig. 5I), inserted ventrally on anal segment, a little wider than long, $28 \times 35 \mu$, taking average length as $28 \mu$, the ramus being longer ventrally ( $3 \mathrm{I} \mu$ ) than dorsally $(25 \mu)$. Long naked setule on outer margin $3 I \mu$ long. Outer lateral seta $\mathrm{I} 20 \mu$ and naked. Outermost terminal seta $180 \mu$ with lateral spinules. Innermost terminal seta long, $45 \mathrm{I} \mu$, and naked. Two long median terminal setae $460 \mu$ (outer) and $660 \mu$ (inner), both with lateral spinules and their "pegged" regions punctate. These 2 setae inserted between ventral flap (with rows of spinules) and dorsal flap of form shown in figure and bearing very small spinules near pedicellate dorsal seta ( $33 \mu$ long and naked). Group of 2-3 minute hairs on dorsal surface of ramus.

Dorsal surface of prosome with only a few hairs. Dorsal surface of urosome with more abundant hairs as in Pl. 6, fig. 50 ; ventral surface with very few hairs. Ratio of length of prosome to that of urosome $2.45:$ r.

Egg sac (Pl. 6, fig. 49) elongated and rather stout, about 8 Io $\times 300 \mu$, more than twice as long as the urosome, and containing many eggs about $52 \mu$ in diameter.

Rostral area (Pl. 7, fig. 52) rather pointed.
First antenna with armature as in S. kossmanni and S. affinis. All setae apparently naked. Lengths of segments (measured as before) 30 ( $67 \mu$ along anterior edge), Io7, 29, 53, 46, 23, and I5 $\mu$ respectively. Terminal aesthete and adjacent seta with common base. Sclerite on ventral surface of third segment. Long terminal seta $234 \mu$ in length, distinctly less than length of antenna ( $340 \mu$ ).

Second antenna (Pl. 7, fig. 53) 3-segmented, third segment showing no evidence of division. Armature 1 ; $x ; 3+5+\mathrm{x}$ claw, as in 2 previous species. Seta on
segment I unusually long ( $165 \mu$ ) and setose. Seta on segment 2 relatively short $(44 \mu)$ and naked. Claw $68 \mu$ along its axis. On anterior surface near base of claw a short vermiform protrusion (aesthete ?). Anterior surface of second antenna pilose as in figure.

Labrum (Pl. 7, fig. 54) with attenuated unornamented lobes.
Mandible (Pl. 7, fig. 55) with elements of outer row beginning as stout spines and diminishing to slender spinules; first element in inner row not much larger than rest ; a patch of spinules on posterior proximal surface of mandible. Paragnath a small lobe as in S. affinis. First maxilla with 4 elements as in 2 previous species, but ornamented spiniform element only very finely spinulose. Second maxilla (Pl. 7, fig. 56) with first segment ornamented with a few spinules on both anterior and posterior surfaces and with its proximal ventral margin angularly produced. Second segment with postero-inner finely barbed seta, long inner spiniform seta with its posterior surface spinulose but anterior surface smooth, and with terminal spiniform process spinulose and showing 2 prominent spines near base. Maxilliped (Pl. 7, fig. 57) with first segment unarmed, second with usual 2 setae and with spinules as in figure, and third with 2 setae (one spinulose, other naked) and terminal spiniform process.

Area between maxillipeds and first pair of legs not protuberant and resembling that in S. kossmanni.

Rami of legs $\mathrm{I}-4$ like those in 2 previous species, with same spine and setal formula. Fine ornamentation much like that in S. kossmanni. Last segment of endopod of leg 2 without a bifurcated spinous process (Pl. 7, fig. 58), and having a form somewhat different from that in S. kossmanni. Last segment of endopod of leg 3 (Pl. 7, fig. 59) of a form slightly different from S. kossmanni. Leg 4 (Pl. 7, fig. 60) with inner seta on coxa relatively short $(26 \mu)$ and naked. Slightly barbed inner seta on second segment of exopod shorter than setae on third segment, recurved, and lying (in alcoholized specimens) over the posterior surface of ramus. Endopod (Pl. 8, fig. 6I) with 2 segments clearly separated. First segment $3 \mathrm{I} \times 28 \mu$, with inner seta $58 \mu$ long and feathered. Second segment $69 \mu$ long, $28 \mu$ in greatest width, and $\mathrm{I} 8 \mu$ wide at narrowest point, its feathered inner seta $74 \mu$, inner terminal spine $76 \mu$ with a very narrow lamella along one edge, and outer terminal spine $55 \mu$ with finely serrated lamellae and with a delicately trifurcate tip. Row of hairs on outer margin of this segment interrupted at slight indentation.

Leg 5 (Pl. 8, fig. 62) with free segment swollen on inner margin, its greatest dimensions $39 \times$ r9 $\mu$. Two terminal naked setae extremely unequal, inner $34 \mu$, outer $170 \mu$. Seta on body near insertion of free segment about $35 \mu$ and feathered.

Leg 6 probably represented by the 2 setae on area of attachment of egg sac (see Pl. 6, fig. 50).

Colour in life in transmitted light translucent to grayish, eye red, egg sacs gray.
Male. Body (Pl. 8, fig. 63) with prosome more slender than in female. Length (without ramal setae) $0.73 \mathrm{~mm} .(0.72-0.73 \mathrm{~mm}$.$) and greatest width 0.29 \mathrm{~mm}$. ( $0.28-0.29 \mathrm{~mm}$.), based on 3 specimens (allotype, I paratype, and I specimen collected I4th December, 1963). Ratio of length to width of prosome $1 \cdot 62:$ I.

Segment of leg 5 (Pl. 8, fig. 64) $46 \times 79 \mu$. Ventral intersegmental sclerite absent. Genital segment a little longer than wide, $125 \times 104 \mu$, with sides in dorsal view nearly parallel. Three postgenital segments $42 \times 69,33 \times 55$, and $20 \times 53 \mu$ from anterior to posterior.

Caudal ramus like that of female. Surfaces of prosome and urosome, as in female, sparsely ornamented with hairs. Ratio of length of prosome to that of urosome r•70: I.

Rostral area, first antenna, second antenna, labrum, mandible, paragnath, and furst maxilla resembling those in female. Second maxilla much like that of female, with same process on first segment, but with long inner seta less strongly developed and with terminal spiniform process weaker and showing near base only 1 prominent spine, the second being greatly reduced in size. Maxilliped (Pl. 8, fig. 65) slender. Spinules on second segment arranged differently than in 2 previous species. Claw II7 $\mu$ long (measured along its axis) and showing 2 slight flexures, with only indication of division being an interruption in fringe of delicate hyaline spinules along concave margin. Two setae near base of claw $67 \mu$ (with a few barbs near tip) and $8 \mu$ (naked).

Area between maxillipeds and first pair of legs resembling that of female.
Legs $I-4$ resembling those of female, with same spine and setal formula.
Leg 5 (Pl. 8, fig. 66) with free segment lacking inner swelling, $18 \times 9 \mu$. Two terminal setae $20 \mu$ (inner) and $58 \mu$ (outer), ratio between them being $2 \cdot 9: I$, instead of $7:$ I as in female. Seta on body near insertion of free segment about $20 \mu$ long and slightly feathered.

Leg 6 (see Pl. 8, fig. 64) resembling that of S. kossmanni, with a minute spinous process and 2 unequal setae, one naked ( $64 \mu$ ), other feathered ( $20 \mu$ ).

Spermatophores not observed.
Colour in life in transmitted light as in female.
(The specific name longiseta, Latin $=$ long seta, alludes to the unusually long terminal seta on the fifth leg in the female).

Comparison with related species. From the four species of Stellicola known to have two postgenital segments in the female, S. longiseta may readily be separated by its very long seta on leg 5. In addition, this species from Mithrodia has a caudal ramus which is a little wider than long, instead of $4:$ I as in S. gracilis (Thompson \& A. Scott, I903), about 2 : I as in S. lankensis (Thompson \& A. Scott, r903), and $6 \cdot 3$ : I or 7 : I as in S. affinis. The female of the species from Madagascar whose description by Humes and Ho is in press, although having a nearly quadrate caudal ramus, differs from $S$. longiseta in having a rounded rostrum, in the seta on the first segment of the second antenna being not unusually long, in the two setae on the endopod of leg 4 being finely barbed instead of feathered, in the two terminal setae on leg 5 having a ratio of $3: x$ instead of $7: x$, and in the ratio of the length of the prosome to that of the urosome being 2.0 : I instead of $2.45: \mathrm{I}$. In the male, the species of Humes and Ho differs from S. longiseta in having the genital segment somewhat tapered anteriorly instead of having nearly parallel sides, and in the claw of the maxilliped being evenly recurved instead of showing two flexures.

From all four of these species S. longiseta may be further distinguished by details in ornamentation of the appendages.
S. longiseta appears to be closest to the species to be described by Humes and Ho, both having a very short caudal ramus and a somewhat similar genital segment in the female.

## Stellicola femineus n. sp.

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\text { Pl. 8, fig. } 67 \text {; Pl. 9, figs. 68-75 ; Pl. Io, figs. } 76-84 \text {; Pl. II, figs. 85-92 }
$$

Type material. 8 ㅇ, $90^{\text {ta }}$, and I copepodid from I starfish, Leiaster leachi Gray, in a depth of 0.5 m ., Pte. Mahatsinjo, Nosy Bé, Madagascar. Collected 8th August, 1960. Holotype female, allotype, and II paratypes (5 $9,6 \delta^{\top}$ ) deposited in the British Mus. (Nat. Hist.) Reg. No. I966.12.7.I0-I2, and the remaining paratypes in the collection of A. G. Humes.

Other specimens. 4 ㅇ, $9 \delta^{\text {t }}$ from I starfish, Leiaster speciosus von Martens, in 0.5 m., Pte. Ambarionaomby, Nosy Komba, near Nosy Bé, Madagascar, 2nd October, I960.

Female. Body (Pl. 8, fig. 67) with broad flattened prosome. Length (not including setae on caudal rami) $\mathrm{I} \cdot 4 \mathrm{I} \mathrm{mm}$. ( $\mathrm{I} \cdot 32-\mathrm{I} \cdot 49 \mathrm{~mm}$.) and greatest width 0.94 mm . ( $0.88-0.99 \mathrm{~mm}$.), based on Io specimens (holotype, 7 paratypes, and 2 specimens from Leiaster speciosus). Ratio of length to width of prosome I•06: I. Segment of leg I completely fused with head. Epimeral areas of segments of legs I and 2 pointed posteriorly ; those of segment of leg 3 also pointed but indented as in figure. Segment of leg 4 small, with its tergum and rounded epimeral areas partly overlapped by preceding segment.

Segment of leg 5 (Pl. 9, fig. 68) I64 $\times 257 \mu$. Intersegmental sclerite not evident. Genital segment broad and flattened, $135 \times 239 \mu$, wider than long, with expanded rounded lateral margins. Areas of attachment of egg sacs located posteriorly and slightly dorsally ; each area (Pl. 9, fig. 69) with 2 unequal feathered setae 34 and I7 $\mu$ in length, each arising from a pedicel. Three postgenital segments $44 \times 99$, $39 \times 89$, and $59 \times 77 \mu$ from anterior to posterior.

Caudal ramus (Pl. 9, fig. 70), inserted slightly ventrally, subquadrate, $30 \times 33 \mu$, a little wider than long. Long naked setule $(55 \mu)$ midway on outer margin. Pedicellate dorsal seta $60 \mu$ and feathered. Outer lateral seta IOI $\mu$ and naked, inserted close to outermost terminal seta ( $208 \mu$ with straight lateral spinules). Innermost terminal seta $234 \mu$ with straight lateral spinules. Two long terminal setae, inserted between dorsal (smooth) and ventral (with row of minute spinules) flaps, $396 \mu$ (outer) and $540 \mu$ (inner) and both with unusually long hairlike recurved lateral spinules.

Dorsal surface of prosome with short hairs. Dorsal and ventral surfaces of urosome with many hairs as shown in Pl. 9, fig. 68. Ratio of length of prosome to that of urosome 2.32: I.

Egg sac (see Pl. 8, fig. 67) moderately elongated and stout, $682 \times 34 \mathrm{I} \mu$, extending far beyond ends of caudal rami, and containing many eggs about $70 \mu$ in diameter.

Rostral area (Pl. 9, fig. 7x) prominent, its posterior margin a little truncated.
First antenna (Pl. 9, fig. 72) 7 -segmented, lengths of segments (measured along their posterior non-setiferous margins) being 46 ( $35 \mu$ along anterior margin), 107, $34,36,25,13$, and $12 \mu$ respectively. Formula for armature as in 3 previous species. Certain setae with short hairs as in figure. Ventral sclerite on third segment. Long terminal seta $203 \mu$ in length, distinctly less than length of antenna ( $270 \mu$ ).

Second antenna (Pl. 9, fig. 73) 3 -segmented, $495 \mu$ in length, with no evidence of division in segment 3. Armature 1 ; I; $3+5+\mathrm{I}$ claw as in 3 previous species. Third segment elongated, $300 \mu$ along outer edge, $187 \mu$ along inner edge, with a sclerotized strongly bent pointed process near base of claw (Pl. 9, fig. 74). Claw $96 \mu$ along its axis. All setae naked.

Labrum (Pl. 9, fig. 75) with moderately rounded unornamented lobes.
Mandible (Pl. ro, fig. 76) in general resembling that of S. longiseta but without proximal patch of spinules. Paragnath (see Pl. 9, fig. 7I) a small lobe. First maxilla (Pl. Io, fig. 77) with 4 elements. Second maxilla (Pl. Io, fig. 78) showing second segment with long inner spiniform seta bearing a row of spinules, those in middle of row much longer and stronger ; terminal spiniform process with a single large tooth-like proximal spine ( 2 such spines seen on left second maxilla in I female). Maxilliped (Pl. ro, fig. 79) with first segment having a distal patch of spinules, second with I naked and I feathered seta and rows of spinules as in figure, and third with 2 small unequal setae and terminal spiniform process.

Area between maxillipeds and first pair of legs not protuberant and formed as in Pl. 9, fig. 7I.

Rami of legs I-4 (Pl. ro, figs. 80, 8I, 82, and 83) like those in 3 previous species with same spine and setal formula. Endopods of legs I-3 rather elongated; last segment of endopod of leg 2 without a bifurcated spinous process. In leg 4 coxa with inner seta apparently reduced to a mere vestige. Feathered inner seta on second segment of exopod short and lying free of ramus. Endopod (Pl. ro, fig. 84) slender, 2 segments clearly separated. First segment $38 \times 15.5 \mu$ with its inner seta short, $30 \mu$, and finely barbed distally. Second segment $50 \times 12 \mu$ (greatest dimensions), its feathered inner seta $52 \mu$, inner terminal spine $76 \mu$, and outer terminal spine $3 \mathrm{r} \mu$, both spines finely barbed. (In another female first segment $33 \times 20 \mu$, and second segment $58 \times 14.5 \mu$ ). Marginal hairs on segments as in figure.

Leg 5 (Pl. II, fig. 85) with elongated slightly recurved slender free segment, $7 \mathrm{I} \times 22 \mu$ (greatest dimensions), tapering slightly distally. Two terminal setae naked and very unequal, inner $22 \mu$, outer II3 $\mu$. Seta on body near insertion of free segment about $48 \mu$ and feathered.

Leg 6 probably represented by the 2 setae on area of attachment of egg sac (see Pl. 9, fig. 69).
Colour in life in transmitted light orange-red to deep red, eye red, egg sacs red.
Male. Body (Pl. II, fig. 86) with broad flattened prosome as in female. Length (excluding setae on caudal rami) 0.85 mm . ( $0.82-0.88 \mathrm{~mm}$.) and greatest width 0.48 mm . ( $0.46-0.49 \mathrm{~mm}$.), based on 10 specimens (allotype, 8 paratypes, and I
specimen from Leiaster speciosus). Ratio of length to width of prosome I•II: I.
Segment of leg 5 completely fused dorsally with genital segment (Pl. II, fig. 87), and only a faint indication of separation between these 2 segments ventrally; segment of leg 5 and genital segment combined a little longer than wide, $22 \mathrm{I} \times 195 \mu$. No intersegmental sclerite. Four postgenital segments $28 \times 68,27 \times 62,24 \times 57$, and $29 \times 52 \mu$, from anterior to posterior.

Caudal ramus similar to that of female but smaller, $\mathrm{I} 8 \times 2 \mathrm{I} \mu$.
Surfaces of prosome and urosome, as in female, ornamented with hairs. Ratio of length of prosome to that of urosome $1 \cdot 73:$.

Rostral area, first antenna, and second antenna as in female. Labrum (Pl. II, fig. 88) with 2 lobes apparently somewhat more pointed than in female. Mandible, paragnath, first maxilla, and second maxilla like those of female. Maxilliped (Pl. II, fig. 89) without long terminal claw, but instead having a form rather like that of female. First segment without ornamentation, second with 2 small naked setae (one hyaline and with a blunt tip) and bearing a patch of spinules, and third with one of 2 setae at base of naked terminal spiniform process greatly elongated.

Area between maxillipeds and first pair of legs as in female.
Legs I-4 resembling in major features those of female, having same spine and setal formula. In legs 2 and 3 apparently a slight sexual dimorphism in lengths of 3 spines on last segment of endopod (from proximal to distal in leg 2 of male I2, I3, and $24 \mu$, but in female $22,2 I$, and $34 \mu$; in leg 3 of male 12 , I3, and $25 \mu$, but in female 23,24 , and $40 \mu$ ). Dimensions of endopod of leg 4 : first segment $22 \times$ r3 $\mu$, with its seta $2 I \mu$; second segment $3 I \times$ II $\mu$, with its seta $34 \mu$ and spines $50 \mu$ (inner) and $24 \mu$ (outer).

Leg 5 (Pl. II, fig. 90) with rectangular free segment relatively shorter than in female, I9 $\times 9 \mu$, with 2 terminal setae $\mathrm{I} 6 \mu$ (inner) and $56 \mu$ (outer), with ratio of $3.5: \mathrm{I}$, instead of $5: \mathrm{I}$ as in female. Seta on body near insertion of free segment about $22 \mu$ long and feathered.

Leg 6 (Pl. II, fig. 9I) consisting of a posterolateral flap on ventral surface of genital segment and bearing at either side of a small spinous process 2 slender naked setae 46 and $29 \mu$ long.

Spermatophore, observed only inside body of male, of elongated form (Pl. II, fig. 92).

Colour in life in transmitted light paler orange-red than in female, eye red.
(The specific name femineus, Latin = womanly or feminine, alludes to the weakly prehensile, female-like maxilliped in the male of this species).

Comparison with related species. The female of $S$. femineus differs from almost all other known species in the genus in having the free segment of leg 5 at least three times longer than wide. The only species which has similar proportions in leg 5 is the species of Humes and Ho (in press) where the free segment is $65 \times 21 \mu$. In this species, however, there are only two postgenital segments in the female.

The male of $S$.femineus is unique in the genus in having a female-like maxilliped, without a well-formed prehensile claw.

## Stellicola pollex n. sp.

Pl. II, fig. 93 ; Pl. I2, figs. 94-IOI ; Pl. I3, figs. IO2-IO9; Pl. I4, figs. IIO-II4.
Type material. 5 우 and $4 \delta^{\lambda}$ from 2 starfishes, Linckia laevigata (L.), in a depth of ro m., at Nosy Ovy (=Berafia), $13^{\circ} 59^{\prime} \mathrm{S}, 47^{\circ} 46^{\prime} 30^{\prime \prime} \mathrm{E}$, to the southwest of Nosy Bé, Madagascar. Collected Ist October, 1964. Holotype, allotype, and 5 paratypes ( 3 ㅇ, 2 O $^{7}$ ) deposited in the British Mus. (Nat. Hist.) Reg. No. 1966.I2.7.13-15, and the remaining 2 paratypes (dissected) in the collection of A. G. Humes.

Female. Body (Pl. II, fig. 93) with broad flat prosome. Length (without setae on caudal rami) 0.99 mm . ( $0.94-\mathrm{r} .03 \mathrm{~mm}$.) and greatest width 0.78 mm . ( $0.68-0.88 \mathrm{~mm}$. ), based on 5 specimens. Ratio of length to width of prosome $0.95:$ r, prosome being slightly wider than long. Segment of leg I separated dorsally and laterally from head by a distinct furrow. Epimera of metasomal segments as in S. femineus.

Segment of leg 5 (Pl. 12, fig. 94) $9 \mathrm{I} \times 180 \mu$. Ventrally between this segment and genital segment a very short intersegmental sclerite. Genital segment broad and flattened, $\mathrm{r} 6 \mathrm{I} \times \mathrm{r} 98 \mu$, wider than long, with expanded rounded lateral margins lobed posteriorly. Areas of attachment of egg sacs located ventrally and hidden in dorsal view by the lobes; each area (Pl. 12, fig. 95) with 2 naked setae, 39 and $35 \mu$ in length, borne on pedicels. Three postgenital segments $35 \times 64,36 \times 62$, and $34 \times 57 \mu$ from anterior to posterior.

Caudal ramus (Pl. I2, fig. 96), inserted ventrally, quadrate, $20 \times 20 \mu$, with naked setule on outer margin $19 \mu$ long. Pedicellate dorsal seta $36 \mu$ and feathered. Outer lateral seta $60 \mu$ and naked. Outermost terminal seta $127 \mu$ and innermost $96 \mu$, both with lateral spinules. Two long terminal setae, inserted between flaps as in S. femineus, $320 \mu$ (outer) and $495 \mu$ (inner), both with short spinules.

Dorsal surface of prosome with scattered hairs (not shown in Pl. II, fig. 93, because of the reduced scale). Dorsal surface of urosome with hairs and refractile points as in Pl. 12, fig. 94 ; ventral surface with very little ornamentation. Ratio of length of prosome to that of urosome $2 \cdot 5:$ I.

Egg sacs not present on any of females collected.
Rostral area as in S. femineus, though posterior margin less truncated.
First antenna (Pl. 12, fig. 97) more slender than in S. femineus, but with same segmentation and armature. Lengths of segments (measured as before) 44 ( $35 \mu$ along anterior margin), $116,45,50,33,20$, and $16 \mu$ respectively. One seta on segment 6 and 4 setae on segment 7 with lateral hairs ; rest of setae naked. Terminal seta II7 $\mu$, about one-third length of antenna ( $330 \mu$ ).

Second antenna (Pl. 12, fig. 98) slender as in S. femineus, with third segment showing no indication of division. Armature I; I; $3+5+1$ claw as in 4 previous species. Near base of claw a small spinous process. Claw $6 \mathrm{r} \mu$ along its axis. All setae naked.

Labrum as in S. femineus, though lobes a little more rounded.
Mandible (Pl. I2, fig. 99) with slender spinules along outer margin and row of dentiform spinules along inner margin (proximal spinule enlarged and preceded by
a slight flange). Paragnath (Pl. I2, fig. IOo) a small lobe with very slender spinules. First maxilla in general like that of S.femineus. Second maxilla (Pl. r2, fig. ror) with first segment unarmed, second with 2 postero-inner elements (a slender barbed seta and a long spiniform seta ornamented with a row of spinules along its distal edge and showing a very weak line of division proximally) and terminating in a spiniform process bearing rows of teeth as in figure. Maxilliped (Pl. 13, fig. 102) resembling in major features that of $S$. femineus, though details of ornamentation somewhat different.

Area between maxillipeds and first pair of legs as in S. femineus.
Rami of legs I-4 (Pl. I3, figs. I03, I04, I05, and I06) segmented as in previous 4 species, with similar spine and setal formula, except for endopod of leg 4 which is 0-o ; II. Endopods of legs $\mathrm{I}-3$ rather elongated as in S. femineus ; last segment of endopod of leg 2 without a bifurcated spinous process. Leg 4 with only a vestige of inner coxal seta. Inner seta on second segment of exopod short $(22 \mu)$ and apparently naked. Endopod (Pl. 13, fig. 107) $4 \mathrm{I} \times$ 10 $\mu$, only incompletely divided into 2 segments, its inner margin entire. Two inner setae usually seen in Stellicola here absent, and only armature of endopod consisting of 2 terminal smooth spines $60 \mu$ (inner) and 3I $\mu$ (outer) in length. Rows of hairs along outer and inner margins of endopod, outer row interrupted at incomplete division of ramus.

Leg 5 (Pl. 13, fig. 108) with free segment $55 \times 27 \mu$ (greatest dimensions, its inner proximal margin somewhat irregular and produced). Two terminal setae naked and unequal, inner $43 \mu$, outer $56 \mu$. Seta on body near insertion of free segment about $37 \mu$ and slightly feathered.

Leg 6 probably represented by the 2 setae on area of attachment of egg sac (see Pl. 12 , fig. 95).

Colour in life in transmitted light slightly opaque, eye red, egg sacs gray.
Male. Body (Pl. I3, fig. Iog) resembling that of female. Length (excluding setae on caudal ramus) 0.55 mm . $(0.53-0.56 \mathrm{~mm}$.) and greatest width 0.36 mm . ( $0.35-0.37 \mathrm{~mm}$.), based on 4 specimens. Ratio of length to width of prosome I.07: I.

Segment of leg 5 and genital segment fused (Pl. r4, fig. Iro) as in S. femineus; these fused segments $127 \mu$ long, $I I 5 \mu$ wide just in front of leg 5 , and IO5 $\mu$ wide behind leg 5. No intersegmental sclerite. Four postgenital segments $28 \times 46$, $23 \times 43,22 \times 40$, and $\mathrm{r} 8 \times 36 \mu$ from anterior to posterior.

Caudal ramus similar to that of female but smaller, $12.5 \times 13 \mu$.
Surfaces of prosome and urosome, as in female, ornamented with hairs. Ratio of length of prosome to that of urosome 2.07: I.

Rostral area and first antenna as in female. Second antenna also resembling that of female, but having a conspicuous thumb-like process on inner margin of third segment (Pl. r4, fig. IrI). Labrum, mandible, paragnath, first maxilla, and second maxilla like those in female. Maxilliped (Pl. I4, fig. Ir2) slender, with long terminal claw. First segment unarmed, second with 2 naked setae and 2 patches of spinules, third short and unarmed. Proximal half of claw probably representing fourth segment. Claw only slightly recurved, $\mathrm{I} 30 \mu$ in length along its axis, showing
faint indication of division about midway, with a fringe of small spinules along its concave margin and 2 unequal setae $8 \mu$ (naked) and $26 \mu$ (slightly barbed) near its base.

Area between maxillipeds and first pair of legs as in female.
Legs I-4 resembling those of female, with same spine and setal formula. As in S. femineus a slight sexual dimorphism in lengths of 3 spines on last segment of endopod of legs 2 and 3 (from proximal to distal in leg 2 of male 9, 10, and $22 \mu$, but in female $16 \cdot 5,17 \cdot 5$, and $35 \mu$; in leg 3 of male 8 , 10 , and $20 \mu$, but in female I6.5, I8.5, and $35 \mu$ ). Dimensions of endopod of fourth leg $22 \times 8 \mu$, with inner spine $3 I \mu$ and outer spine I7 $\mu$.

Leg 5 (Pl. I4, fig. II3) with free segment smaller and having nearly parallel sides, $20 \times 8 \mu$, the terminal setae $18 \mu$ (inner) and $52 \mu$ (outer), with ratio of $2 \cdot 9: \mathrm{I}$, instead of $\mathrm{I} \cdot 3$ : I as in female.

Leg 6 (Pl. I4, fig. II4) consisting of a posterolateral flap on ventral surface of genital segment and bearing 2 slender naked setae $2 I$ and $36 \mu$.

Spermatophores not observed.
Colour in life in transmitted light as in female.
(The specific name pollex, Latin $=\mathrm{a}$ thumb, refers to the thumb-like process on the third segment of the second antenna of the male).

Comparison with other species. S. pollex has two readily observable characters by which it may be distinguished from all other species in the genus, namely, the thumb-like process on the third segment of the second antenna in the male and the armature of the endopod of leg $4(0-0 ;$ II) in both sexes.

In the fifteen previously known species and in the four species described above
 a stable and constant feature in the genus. The unusual armature in S. pollex might suggest at first glance that this species should be removed to a separate genus. However, other features of S. pollex (first antenna, second antenna, mouthparts, legs I-5, and body form) conform very closely to the pattern of Stellicola. The structure of the mandible (which is an important generic character in the Lichomolgidae) is very much like that in other species of the genus. Therefore, in spite of the rather remarkable difference in the armature of this endopod, we are considering the species to belong to Stellicola.

## Stellicola oreastriphilus Kossmann, 1877

Pl. I4, figs. II5-I20

Two females and one male were recovered from washings of a single starfish, Protoreaster nodosus (L.), in a depth of 2 m ., on Cymodocea, at Ambatoloaka, Nosy Bé, I5th October, I960. This represents a new host record, the species having been previously found on six other starfishes-Asterope carinifera (Lamarck) in the Red Sea by Kossmann (1877), on Protoreaster lincki (Blainville), Culcita schmideliana (Retzius), Pentaceraster mammillatus (Audouin), and Poraster superbus (Möbius) in Madagascar by Humes \& Cressey (196I), and on Choriaster granulatus (Lütken) in Madagascar by Humes \& Ho (in press).

In connection with the description of the five new species above, specimens of S. oreastriphilus (from a lot of approximately 1,000 individuals washed from 200 Protoreaster lincki, in a depth of 10 cm. , at Pte. Mahatsinjo, Nosy Bé, 6th September, 1964) were restudied. The dissections were done in lactic acid (see Humes \& Gooding, 1964), enabling us to see certain details not easily observed in the original dissections in glycerine. Notes on these features are offered here as a supplement to the work of Humes \& Cressey (1961).

Female. The flattened genital segment (Pl. 14, fig. II5) expanded laterally, with subparallel lateral margins. A pair of ventral refractile sclerotizations present on sides of segment. Tip of second antenna (Pl. I4, fig. II6) bearing 5 setae and I claw. Paragnath (Pl. 14, fig. 117) a hairy lobe bearing a sclerotized process. Maxilliped (Pl. I4, fig. II8) with second segment having 2 setae (one surficial, other on a hyaline base at inner marginal angle) and a crescentic row of spinules; third segment with 2 very unequal small setae at base of terminal spiniform process. Endopod of leg 4 (Pl. I4, fig. II9) with marginal hairs as in figure.

Male. Segment of leg 5 and genital segment (Pl. I4, fig. I20) fused completely dorsally and their ventral separation suggested by a very indistinct line. Fused segments $120 \mu$ long, 109 $\mu$ wide just in front of leg 5 , and $\operatorname{\text {IoI}~} \mu$ wide posterior to leg 5. (The rather distinct separation of the two segments shown by Humes \& Cressey, 1961, fig. 25, is not present in the material which we have re-examined).

## Stellicola caeruleus (Stebbing, 1900)

$$
\text { Pl. } 15 \text {, figs. } 121-128 \text {; Pl. } 16 \text {, figs. } 129-134 \text {; Pl. } 17 \text {, figs. } 135-141
$$

This species was placed by Stebbing ( 1900, pp. 664-666, plate LXXIVB) in a new genus Linckiomolgus, but, as Stock (1957) has pointed out, and as will be seen from the redescription below, it belongs more properly to Stellicola.
Through the kindness of Miss Patricia D. Lofthouse we have been able to study syntypes (I female and I male) of S. caeruleus [Brit. Mus. (Nat. Hist.) reg. no. 1928.12.1.3020]. These are labelled "China Sea on blue Linckia", though the type locality given by Stebbing was Feather Island, China Straits, New Guinea. The dissections of these specimens, mounted on two slides, have been returned to the British Museum (Nat. Hist.). Although the condition of the specimens (which were in amplexus) was less than perfect, with certain setae broken or missing, the major features could be observed in the dissections. Stebbing's original description being inadequate in many respects, especially regarding the mouthparts, a redescription of the species based on syntypic material is desirable.

Female. Body (Pl. 15, fig. 12I) with greatly expanded prosome. Length (without setae on caudal rami) $I .23 \mathrm{~mm}$. and greatest width 0.88 mm . Ratio of length to width of prosome 0.97 : I, being a little wider than long. Segment of leg I completely fused with head. Epimeral areas of metasomal segments resembling those of S. femineus.

Genital segment (Pl. I5, fig. I22) wider than long, $156 \times 208 \mu$, broadly rounded laterally in its anterior half and tapering in its posterior half where the areas of
attachment of the egg sacs are located laterally. Dorsally with two longitudinal posterior elevations with sclerotization as in figure. Each egg sac attachment area with 2 unequal setae, one arising from a prominent slender pedicel $3 \mathrm{r} \times 8 \mu$. Three postgenital segments $60 \times 86,42 \times 78$, and $52 \times 72 \mu$ from anterior to posterior.

Caudal ramus (Pl. I5, fig. 123) only a little longer than wide, $32 \times 28 \mu$.
Ratio of length of prosome to that of urosome 2.32: I.
Egg sac broken on female examined; an isolated egg about $74 \mu$ in diameter.
Rostral area (Pl. I5, fig. 124) incomplete posteriorly.
First antenna (Pl. 15, fig. 125) 7 -segmented, lengths of segments (measured along their posterior non-setiferous margins) being 55 ( $44 \mu$ along anterior margin), rr3, 39, 43, 33, 15 , and $14 \mu$ respectively. Formula for armature 4 , $13(5+2+6), 6$, $3,4+\mathrm{r}$ aesthete, $2+\mathrm{I}$ aesthete, and $7+\mathrm{r}$ aesthete, as in all 5 new species described above and as in S. oreastriphilus. Ventral sclerite present on third segment.
Second antenna (Pl. I5, fig. 126) with a single claw $79 \mu$ along its axis and with armature as in S.femineus. Third segment $\mathrm{r} 66 \mu$ along outer side, $9 \mathrm{r} \mu$ along inner side, with no evidence of division.

Labrum as in Pl. 15, fig. I24.
Mandible (Pl. 15, fig. 127) with first 2 elements of inner row only slightly larger than succeeding ones. Paragnath a small lobe with coarse hairs. First maxilla with 4 elements. Second maxilla (Pl. I5, fig. I28) with second segment with long inner spiniform seta bearing a row of spinules, those in middle of row somewhat longer; terminal spiniform process with strong graduated teeth. Maxilliped (Pl. I6, fig. 129) 3 -segmented, with second segment apparently having only I seta, and with 2 very unequal spinules near base of short terminal claw-like process.

Area between maxillipeds and first pair of legs resembling that of S. femineus.
Rami of legs I-4 (Pl. 16, figs. I30, I3I, I32, and 133) segmented and armed as in S. kossmanni, S. affinis, S. longiseta, and S. femineus, except for last segment of exopod of leg 3 which has formula of II, I, 5. In leg 4 coxa with only a minute knob probably representing a vestige of inner coxal seta seen in other species. Inner seta on second segment of exopod $25 \mu$ long and naked. Endopod 2 -segmented, 2 segments distinctly separated. First segment $27 \times 15 \mu$, with its inner seta $36 \mu$ and finely barbed. Second segment $3 \mathrm{I} \times$ I2 $\mu$, its inner seta $42 \mu$ and feathered, inner terminal spine $66 \mu$ and barbed, outer spine $29 \mu$ with only a few minute barbs. (Marginal hairs on endopod segments not discernible).

Leg 5 (Pl. r6, fig. 134) with free segment about $44 \times 17 \mu$, bearing 2 very unequal terminal setae.

Leg 6 probably represented by the 2 setae on area of attachment of egg sac (see Pl. 15, fig. 122).

Male. Body (Pl. 17, fig. 135) with prosome somewhat less expanded than in female. Length (excluding ramal setae) 0.52 mm . and greatest width 0.32 mm . Ratio of length to width of prosome $\mathrm{r} \cdot 09$ : r , being a little longer than wide.

Segment of leg 5 fused with genital segment (Pl. I7, fig. 136), as in S. femineus, S. pollex, and S. oreastriphilus. These 2 segments combined longer than wide: iro $\mu$ in length, $83 \mu$ wide at level of fifth legs, and $75 \mu$ wide posterior to these
legs, where lateral margins are subparallel. Four postgenital segments $30 \times 47$, $30 \times 44,20 \times 40$, and $22 \times 37 \mu$ from anterior to posterior.

Caudal ramus similar to that of female but smaller, $19 \times 15 \mu$.
Ratio of length of prosome to that of urosome $2 \cdot 05$ : I.
Rostral area (Pl. I7, fig. I37) well-defined posteriorly, with its border there slightly indented.

First antenna, second antenna, labrum, mandible, paragnath, and first maxilla like those of female. Second maxilla (Pl. I7, fig. I38) with second segment much like that of female, but with first segment showing 3 peculiar sclerotized processes arising ventrally. (Possibly these are adhesive pads). Maxilliped (Pl. I7, fig. I39) small, 2 -segmented, with terminal claw $22 \mu$ along its axis. Both segments without ornamentation or armature ; a small knob on basal area of claw.

Legs $\mathrm{I}-4$ like those in female, with same spine and seta formula.
Leg 5 (Pl. I7, fig. I40) with a small free segment, $12 \times 7 \mu$, bearing 2 terminal setae $\mathrm{I} 8 \mu$ (inner) and $55 \mu$ (outer).

Leg 6 (Pl. I7, fig. I4I) consisting of the usual posterolateral flap on ventral surface of genital segment and bearing 2 unequal setae.

Spermatophores not observed.
Comparison with other species. Based on our study of syntypes, S. caeruleus shows three features not found in the other nineteen species of the genus, as far as known : the two posterior sclerotized elevations on the dorsal surface of the genital segment of the female, the three peculiar sclerotized processes on the first segment of the second maxilla in the male, and the formula of II, I, 5 on the last segment of the exopod of leg 3 in both sexes. A small 2 -segmented maxilliped with a short claw is also found in the male of S. holothuriae (Ummerkutty), but this Indian species differs from $S$. caeruleus in having the formula III, I, 5 on the last segment of the exopod in leg 3 and in the shape of the caudal ramus (much wider than long). $S$. caeruleus may thus readily be distinguished from other members of the genus.

## NOTES ON THE VARIABILITY OF CERTAIN FEATURES IN THE GENUS STELLICOLA

The twenty species here recognized in the genus Stellicola exhibit certain variations in external structure worthy of note. The second antenna may bear terminally a single claw, two claws, or three claws. Those with three claws are the four West African species: S. frequens, S. astropectinis, S. luidiae, and S. lautus. (In all of these the middle spine on the last segment of the endopod of leg 2 is unusually short, whereas in other species, as far as known, this spine is not thus shortened; the second segment of the endopod of leg 4 has a sharp spinous process midway on its outer margin opposite the inner seta). The only species with two claws is S. clausi. The remaining fifteen species have a single claw. The third segment of the second antenna in some species may show an incomplete division (as in the species to be described by Humes and Ho, in press, and in S. kossmanni).

The armature of legs $\mathrm{I}-4$ is similar in all species (where it has been described) except for S. caeruleus, where the formula for the last segment of the exopod of leg 3 is II, I, 5, and S. pollex, where the endopod of leg 4 has a formula of o-0 ; II.

In a few species the basis of leg 4 is greatly elongated and the inner coxal seta is absent, this seta being perhaps represented by a small knob, as in $S$. femineus, $S$. pollex, and S. caeruleus. S. thorelli, S. pleurobranchi, S. curticaudatus, S. longicaudatus, and $S$. holothuriae appear to be similarly constructed, but the exact nature of the protopodal segments of leg 4 is impossible to determine from the descriptions and figures of these species. S. oreastriphilus represents an intermediate form between those species with an elongated basis and those with a short basis (as in S. kossmanni, for example).

The maxilliped of the male in most species is elongated and bears a long prehensile claw, but in $S$. femineus it is female-like and only weakly prehensile, and in $S$. caeruleus it is small, 2 -segmented, with a short claw.

The second maxilla of the male of $S$. caeruleus is remarkable in the development of three peculiar sclerotized processes on the first segment. In most other species, as far as known, there is no sexual dimorphism in this appendage, but in S. longiseta and $S$. affinis the second maxilla of the male shows slight differences from that of the female.

In the males of certain species the segment of leg 5 and the genital segment are almost completely fused, as in S. oreastriphilus, S. femineus, S. pollex, and S. caeruleus. It may be noted that the tendency in leg 4 toward elongation of the basis and loss of the inner coxal seta occurs in the same four species.

The males of five species (S. thorelli, S. pleurobranchi, S. lankensis, S. curticaudatus, and S. longicaudatus) are unknown, and the available descriptions of the females are lacking in detail. Hence, it is impossible at present to determine whether or not these variations exist in them.

The significance of such variations as mentioned above is not clear. The four West African species seem to be closely related and set apart from the rest, perhaps constituting an evolutionary line within the genus. It will be necessary, however, to have much more information on the species within the genus before well-founded conclusions regarding evolutionary relationships can be made. Undoubtedly many more species of Stellicola remain to be discovered, since relatively few species of potential asteroid hosts have been examined.

## Keys to the species of STELLICOLA

The preparation of keys for the identification of the species of Stellicola presents certain difficulties, since detailed information regarding various structures in several species is not available in the existing descriptions or figures. Furthermore, the males of five species (thorelli, pleurobranchi, lankensis, curticaudatus, and longicaudatus) are unknown and consequently cannot be included in the key. The keys given here are entirely artificial and are presented only as aids in identification. Final determination of a species should be made by reference to the original descriptions and figures, or to actual specimens, if available.

## Females

r Two postgenital segments ..... 2
Three postgenital segments ..... 6
2 Caudal ramus $2 \times$ or more than $2 \times$ longer than wide. ..... 3
Caudal ramus short, nearly quadrate ..... 5

3 Caudal ramus at least $4 \times$ longer than wide
Caudal ramus about $2 \times$ longer than wide .
4 Caudal ramus $6 \cdot 3-7 \times$ longer than wide affinis
Caudal ramus $4 \times$ longer than wide

5 Seta on first segment of second antenna unusually long, reaching nearly to end of appendage ; free segment of leg 5 swollen on inner margin ; caudal ramus slightly wider than long, $28 \times 35 \mu$
longiseta
Seta on first segment of second antenna not unusually long; free segment of leg 5 with sides nearly parallel ; caudal ramus slightly longer than wide, $28 \times 23 \mu$ species of Humes and Ho, in press
6 With more than I claw on last segment of second antenna 7
With only I claw on last segment of second antenna II
7 With 3 claws on last segment of second antenna . . . . . . 8
With 2 claws on last segment of second antenna . . . . . . clausi
8 Length about $\mathrm{I} \circ \mathrm{omm}$. genital segment a little longer than wide . . . 9
Length $\mathrm{r} \cdot 3-\mathrm{r} \cdot 6 \mathrm{~mm}$. ; genital segment about as long as wide . . . . io
9 Caudal ramus $48 \times 36 \mu$, ratio of $\mathrm{I} \cdot 33$ : I . . . . . . . frequens
Caudal ramus $60 \times 28 \mu$, ratio of $2 \cdot 14$ : I . . . . . astropectinis
ro Caudal ramus $6 \mathrm{I} \times 38 \mu$, ratio of $\mathrm{I} \cdot 6 \mathrm{I}: \mathrm{I}$. . . . . . . luidiae
Caudal ramus $96 \times 43 \mu$, ratio of $2 \cdot 23$ : . . . . . . . lautus
I Formula of endopod of fourth leg o-o ; II . . . . . . pollex
Formula of endopod of fourth leg o-i ; II, I . . . . . . . I2
12 With 2 posterior dorsal sclerotized elevations on genital segment . caeruleus
Without such elevations
13 Free segment of leg 5 a little more than $3 \times$ longer than wide and slightly recurved; length 1.4 mm . . . . . . . . . . . . femineus
Free segment of leg 5 less than $3 \times$ longer than wide and not recurved; length $\mathrm{I} \cdot 2 \mathrm{~mm}$. or less

14
14 Ratio of length of prosome to urosome $\mathrm{I} \cdot 87: \mathrm{I}$, ratio of length to width of prosome I•45: I
kossmanni
Ratio of length of prosome to urosome 2.4-3.3: I ; ratio of length to width of prosome 0.94-I. 22 : I

I5
I5 Ratio of body length to width about I-28: I . . . . . longicaudatus
Ratio of body length to width about $\mathrm{I} \cdot 5$ : I . . . . . . . 16
16 Two setae on free segment of leg 5 about equal in length . . . . . 17
Two setae on free segment of leg 5 distinctly unequal in length . . . . 18
17 Basis of leg 4 greatly elongated, ratio of its length to length of exopod about 13.5:5
pleurobranchi
Basis of leg 4 not as elongated, ratio of its length to length of exopod about $9: 5$
oreastriphilus
I8 Postgenital segments and caudal rami together more than $4 \times$ as long as genital segment
thorelli
Postgenital segments and caudal rami together only a little longer than genital segment or shorter than that segment
i9 Postgenital segments and caudal rami together a little longer than genital segment
curticaudatus
Postgenital segments and caudal rami together a little shorter than genital segment
holothuriae

## Males

I Three postgenital segments . . . . . . . . . . ${ }^{2}$
Four postgenital segments . . . . . . . . . . 5
2 Caudal ramus distinctly elongated . . . . . . . . . 3
Caudal ramus nearly quadrate . . . . . . . . . 4


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## EXPLANATION OF FIGURES

All figures were drawn with the aid of a camera lucida. The letter after the explanation of each figure refers to the scale at which it was drawn.

Abbreviations used : $\mathrm{A}_{1}=$ first antenna, $\mathrm{A}_{2}=$ second antenna, $\mathrm{MD}=$ mandible, $\mathrm{P}=$ paragnath, $\mathrm{MX}_{1}=$ first maxilla, $\mathrm{MX}_{2}=$ second maxilla, $\mathrm{MXPD}=$ maxilliped, $\mathrm{P}_{1}=\operatorname{leg} \mathrm{I}$.

## PLATE I

Stellicola kossmanni n. sp., female
Fig. I. Dorsal (A).
Fig. 2. Marginal membrane on prosomal segments, dorsal (B).
Fig. 3. Urosome, dorsal (c).
Fig. 4. Area of attachment of egg sac, dorsal (D).
Fig. 5. Caudal ramus and part of anal segment, dorsal (E).
Fig. 6. Rostral area, ventral (c).


Stellicola kossmanni n. sp., female (continued)
Fig. 7. First antenna, anterodorsal (c).
Fig. 8. Second antenna, anterior (F).
Fig. 9. Labrum, ventral (D).
Fig. io. Mandible, posterior (D).
Fig. if. First maxilla, posterolateral (G).
Fig. 12. Second maxilla, posterior (D).
Fig. i3. Maxilliped, anterior (D).
Fig. 14. Area between maxillipeds and first pair of legs, ventral (c).
Fig. 15. Leg i and intercoxal plate, anterior (c).


## PLATE 3 <br> Stellicola kossmanni n. sp., female (continued)

Fig. i6. Leg 2, anterior (c).
Fig. I7. Leg 3, anterior (c).
Fig. I8. Leg 4 and intercoxal plate, anterior (c).
Fig. i9. Leg 5, dorsal (D).
Stellicola kossmanni n. sp., male
Fig. 20. Dorsal (A).
Fig. 2I. Urosome, dorsal (c).


## PLATE 4

Stellicola kossmanni n. sp., male (continued)
Fig. 22. Maxilliped, anterior (F).
Fig. 23. Leg 6, ventral (F).
Fig. 24. Spermatophore, in body of male, dorsal (C).
Stellicola affinis n. sp., female
Fig. 25. Dorsal (A).
Fig. 26. Lateral (A).
Fig. 27. Urosome, dorsal (B).
Fig. 28. Area of attachment of egg sac, dorsal (D).
Fig. 29. Caudal ramus, dorsal (F).
Fig. 30. Rostrum, ventral (c).
Fig. 3I. First antenna, anterodorsal (c).

Bull. Br. Mus. nat. Hist. (Zool.) 15, 5


## PLATE 5

Stellicola affinis n. sp., female (continued)
Fig. 32. Second antenna, posterior (F).
Fig. 33. Labrum, ventral (D).
Fig. 34. Mandible, posterior (D).
Fig. 35. First maxilla, posterior (E).
Fig. 36. Second maxilla, posterior (D).
Fig. 37. Maxilliped, posterior (d).
Fig. 38. Oral and postoral areas, ventral (c).
Fig. 39. Leg I and intercoxal plate, anterior (c).
Fig. 40. Leg 2, anterior (c).
Fig. 4I. Leg 3, anterior (c).


## PLATE 6

Stellicola affinis n. sp., female (continued)
Fig. 42. Leg 4 and intercoxal plate, anterior (c).
Fig. 43. Leg 5, dorsal (D).
Stellicola affinis n. sp., male
Fig. 44. Dorsal (A).
Fig. 45. Urosome, dorsal (в).
Fig. 46. Maxilliped, anterior (F).
Fig. 47. Leg 5, ventral (D).
Fig. 48. Leg 6, ventral (F).
Stellicola longiseta n. sp., female
Fig. 49. Dorsal (H).
Fig. 50. Urosome, dorsal (в).


## PLATE 7

Stellicola longiseta n. sp., female (continued)
Fig. 5I. Caudal ramus, dorsal (E).
Fig. 52. Rostrum, ventral (c).
Fig. 53. Second antenna, anterior (F).
Fig. 54. Labrum, ventral ( F ).
Fig. 55. Mandible, posterior (D).
Fig. 56. Second maxilla, posterior (D).
Fig. 57. Maxilliped, anterior (D).
Fig. 58. Last segment of endopod of leg 2, anterior (F).
Fig. 59. Last segment of endopod of leg 3, anterior (F).
Fig. 60. Leg 4 and intercoxal plate, anterior (c).


## PLATE 8

Stellicola longiseta n. sp., female (continued)
Fig. 61. Endopod of leg 4, anterior (F).
Fig. 62. Leg 5, dorsal (D).
Stellicola longiseta n. sp., male
Fig. 63. Dorsal (A).
Fig. 64. Urosome, dorsal (c).
Fig. 65. Maxilliped, anterior (F).
Fig. 66. Leg 5, dorsal (E).
Stellicola femineus n. sp., female
Fig. 67. Dorsal (h).


## PLATE 9

Stellicola femineus n. sp., female (continued)
Fig. 68. Urosome, dorsal (i).
Fig. 69. Area of attachment of egg sac, dorsal (F).
Fig. 70. Caudal ramus, dorsal (E).
Fig. 71. Rostrum, oral and postoral areas, mouthparts not labelled but in same relative positions as in Plate 5, fig. 38, ventral (A).
Fig. 72. First antenna, dorsal (c).
Fig. 73. Second antenna, posterior (B).
Fig. 74. Tip of second antenna, anterior (F).
Fig. 75. Labrum, ventral (c).


## PLATE Io <br> Stellicola femineus n. sp., female (continued)

Fig. 76. Mandible, posterior (F).
Fig. 77. First maxilla, anterolateral (F).
Fig. 78. Second maxilla, posterior (F).
Fig. 79. Maxilliped, posterior (F).
Fig. 8o. Leg i and intercoxal plate, anterior (B).
Fig. 8i. Leg 2, anterior (B).
Fig. 82. Leg 3, anterior (B).
Fig. 83. Leg 4 and intercoxal plate, anterior (B).
Fig. 84. Endopod of leg 4, anterior (F).


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## PLATE II

Stellicola femineus n. sp., female (continued)
Fig. 85. Leg 5, dorsal (F).
Stellicola femineus n. sp., male
Fig. 86. Dorsal (A).
Fig. 87. Urosome, dorsal (B).
Fig. 88. Labrum, ventral (F).
Fig. 89. Maxilliped, postero-inner (D).
Fig. 90. Leg 5, dorsal (E).
Fig. 9i. Leg 6, ventral (F).
Fig. 92. Spermatophore, inside male, dorsal (B).
Stellicola pollex n. sp., female
Fig. 93. Dorsal (H).


## PLATE 12

Stellicola pollex n. sp., female (continued)
Fig. 94. Urosome, dorsal (c).
Fig. 95. Area of attachment of egg sac, ventral (D).
Fig. 96. Caudal ramus, dorsal (E).
Fig. 97. First antenna, ventral (c).
Fig. 98. Second antenna, posterior (c).
Fig. 99. Mandible, posterior (F).
Fig. ioo. Paragnath, ventral (G).
Fig. ioi. Second maxilla, posterior (D).


## PLATE 13 <br> Stellicola pollex n. sp., female (continued)

Fig. 102. Maxilliped, posterior (D).
Fig. 103. Leg I and intercoxal plate, anterior (c).
Fig. 104. Leg 2, anterior (c).
Fig. 105. Leg 3, anterior (c).
Fig. io6. Leg 4 and intercoxal plate, anterior (c).
Fig. io7. Endopod of leg 4, anterior (E).
Fig. io8. Leg 5, dorsal (D).
Stellicola pollex n. sp., male
Fig. iog. Dorsal (I).


## PLATE 14

Stellicola pollex n. sp., male (continued)
Fig. ino. Urosome, dorsal (F).
Fig. ifi. Third segment of second antenna, anterior (E).
Fig. II2. Maxilliped, postero-inner (D).
Fig. II3. Leg 5, dorsal (G).
Fig. II4. Leg 6, ventral (D).
Stellicola oreastriphilus Kossmann, 1877, female
Fig. II5. Genital segment, dorsal (c).
Fig. in6. Tip of second antenna, posterior (F).
Fig. II7. Paragnath, ventral (E).
Fig. if8. Maxilliped, anterior (D).
Fig. iI9. Endopod of leg 4, anterior (F).
Stellicola oreastriphilus Kossmann, I877, male
Fig. 120. Segment of leg 5 and genital segment, dorsal (c).


## PLATE 15

Stellicola caeruleus (Stebbing, igoo), syntypic female
İig. I2I. Dorsal (H).
Fig. 122. Urosome, dorsal (B).
Fig. 123. Caudal ramus, dorsal (E).
Fig. 124. Rostrum and labrum, ventral (I).
Fig. I25. First antenna, ventral (c).
Fig. 126. Second antenna, anterior (B).
Fig. 127. Mandible, posterior (F).
Fig. 128. Second maxilla, posterior (F).


## PLATE I6

Stellicola caeruleus (Stebbing, igoo), syntypic female (continued)
Fig. 129. Maxilliped, posterior (F).
Fig. i3o. Leg i and intercoxal plate, anterior (c).
Fig. i3i. Leg 2, anterior (c).
Fig. 132. Leg 3, anterior (c).
Fig. 133. Leg 4, anterior (F).
Fig. I34. Leg 5, dorsal (D).


## PLATE I 7

Stellicola caevuleus (Stebbing, 1900) syntypic male
líg. 135. Dorsal (1).
Fig. 136. Urosome, dorsal (F).
Fig. 137. Rostrum, ventral (c).
Fig. I38. Second maxilla, dorsal (E).
Fig. 139. Maxilliped, dorsal (G).
Fig. i40. Leg 5, dorsal (G).
Fig. I4I. Leg 6, ventral (E).



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